CIAT

International Center for Tropical Agriculture

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CGIAR RESEARCH PROGRAM ON Livestock

The inclusion of *Leucaena diversifolia* in Colombian cattle systems: An economic perspective

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Context

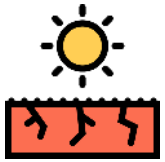
The **forage-based cattle sector plays a key role** in

FOOD
and nutrition security

POVERTY
Alleviation

But it is also associated with **causing negative environmental impacts**:

EMISSIONS
of greenhouse gases



LAND
degradation

WATER
pollution and depletion

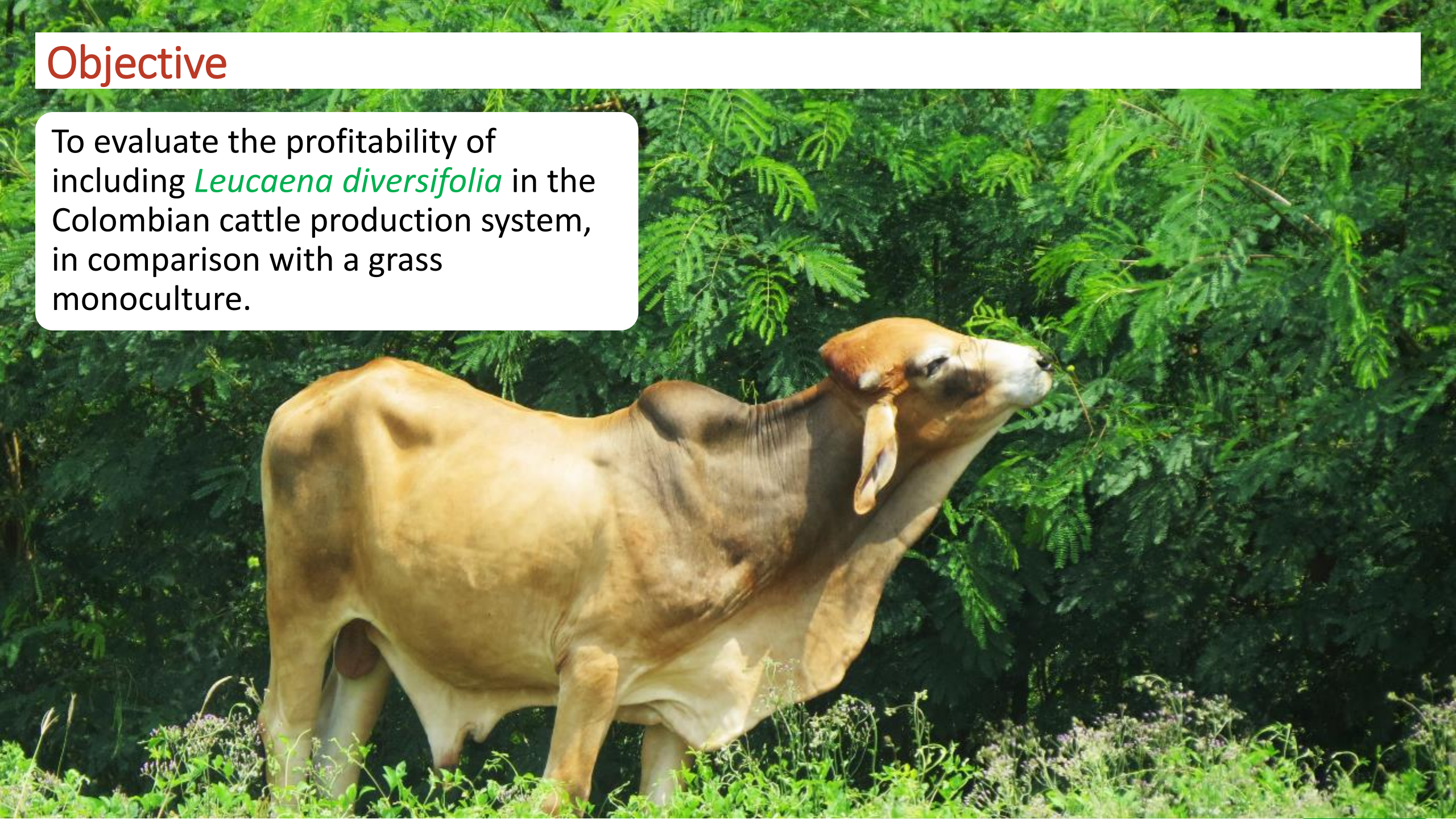
DEFORESTATION

BIODIVERSITY
threatened

- ✓ **Improvements in animal feeding** and **sustainable intensification** are the most promising strategies for mitigating these impacts.
- ✓ The inclusion of **forage legumes in cattle production** systems has the potential to increase yield, efficiency and nutritional value of the forage, with less environmental impact.
- ✓ But **adoption and use by the producers remain limited** due to:
  - Economic factors
  - Lack of knowledge
  - Limited perceived benefits by the producer
  - Risk aversion and uncertainty.

Objective

To evaluate the profitability of including *Leucaena diversifolia* in the Colombian cattle production system, in comparison with a grass monoculture.



Materials and methods

Data source: Monthly field measurements carried out by the International Center for Tropical Agriculture (CIAT) in Palmira, Valle del Cauca, Colombia, between August 2014 and August 2015.

Evaluated diets:

T1) *Brachiaria* hybrid cv. CIAT BR 02/1752 (Cayman) monoculture (100%)

T2) Cayman-*L. diversifolia* association in a proportion of 70:30% (2,000 *Leucaena diversifolia* plants/ha).

Materials and methods

Table 1: Animal response data of T1 and T2

Variable	T1		T2	
	(Mean ± SD)	CV (%)	(Mean ± SD)	CV (%)
Carrying capacity (LSU/ha)	3.36		4.04	
Weight gain (g/animal/d)	440 ± 41	9.3	657 ± 73	11.2
Animal productivity (kg/ha/y)	723 ± 68*		1078 ± 120*	
Time to reach sales weight (months)[1]	18		12	

LSU: 450 kg/animal SD: standard deviation.

*Statistically different at 1% significance level P<0.01.

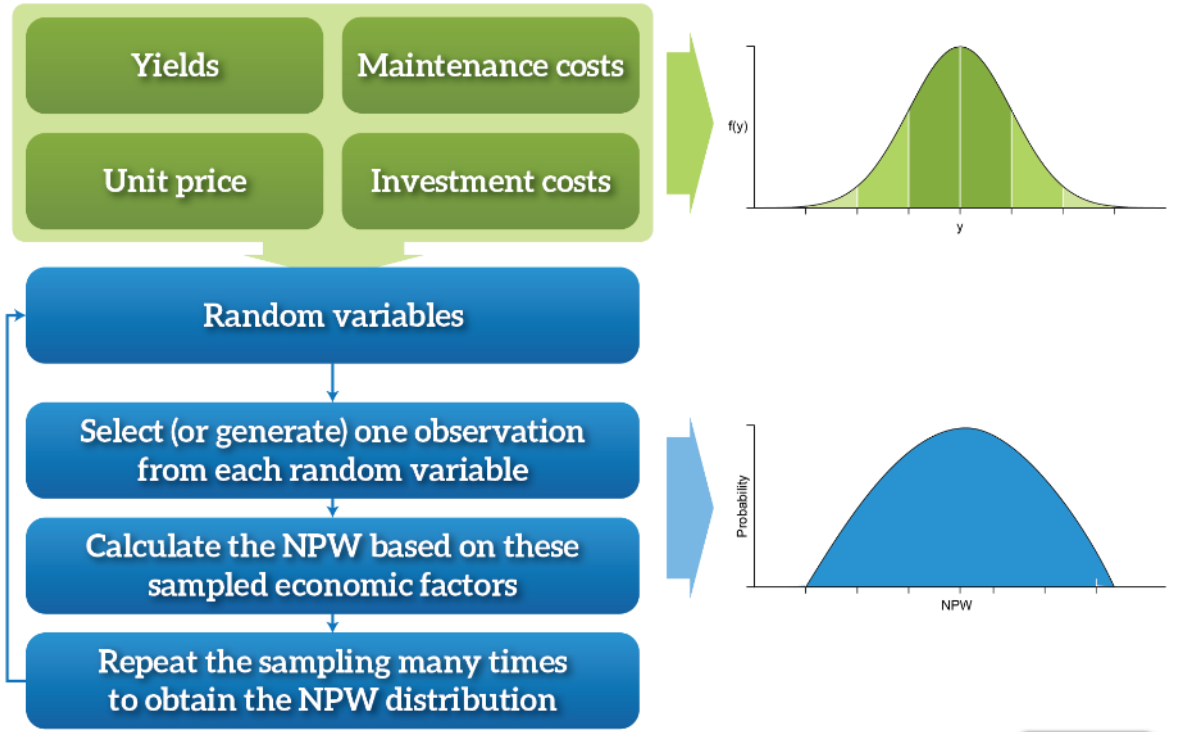
[1]Period of time required to bring a calf with an average weight of 200 kg to a sales weight of 450 kg.

Materials and methods

Economic, risk and sensitivity analyses

- A discounted cash flow model for the estimation of financial profitability indicators was developed.
- A quantitative risk analysis by running a Monte Carlo simulation was carried out.
- Three pasture persistence scenarios and the following variables were randomly combined:
  - ✓ Live weight gain per animal and year
  - ✓ Investment costs
  - ✓ Maintenance costs
  - ✓ Sales price per kg of live weight
  - ✓ Purchase price per kg of live weight.
- Sensitivity and scenario analyses were carried out to identify those variables with the strongest effects on the profitability indicators.

Scheme of a Monte Carlo simulation



Simulation made with **@RISK** Software

Results

Table 2: Summary of profitability indicators of the simulation model.

Decision criteria	Indicator	T1			T2		
Scenarios		S1	S2	S3	S4	S5	S6
NPV	Mean[1]	(288)	(342)	(473)	2,055	1,881	1,716
	SD[2]	447	434	404	697	673	651
	CV	1.55	1.26	0.85	0.34	0.36	0.38
	CI (95%)[3]	(1,135)-558	(1,165)-481	(1,239)-292	743-3,389	610-3,172	484-2965
IRR	Mean	9.7%	19%	17%	22%	21%	21%
	CI (95%)	4%-15%	4%-15%	4%-14%	16%-28%	15%-28%	15%-27%
Benefit/Cost[4]	Mean	0.98	0.90	1.5	1.13	1.12	1.12
	CI (95%)	0.9-1.05	0.9-1.04	0.89-1.03	1.05-1.22	1.04-1.21	1.03-1.20
Payback period (years)	Mean	6	6	6	4	4	4
	CI (95%)	3-8	3-8	3-8	3-5	3-5	3-5
Minimum area (hectares)[5]	Mean	6.54			3.76		

Scenarios were determined by considering three annual degradation rates that decrease the total forage supply and therefore the carrying capacity: for T1 at 1% (S1), 3% (S2) and 8% (S3), and for T2 at 1% (S4), 3% (S5), and 5% (S6), respectively. [1]Mean value of the VPN obtained in the simulation (5,000 iterations and confidence level of 95%); [2]SD: Standard deviation of the NPV with respect to the mean value; [3]CI: Minimum and maximum values in a 95% confidence interval; [4]Quotient between benefits and discounted costs; [5]Minimum area required for two basic Colombian salaries in hectares (1 CBS=US$279).

Results

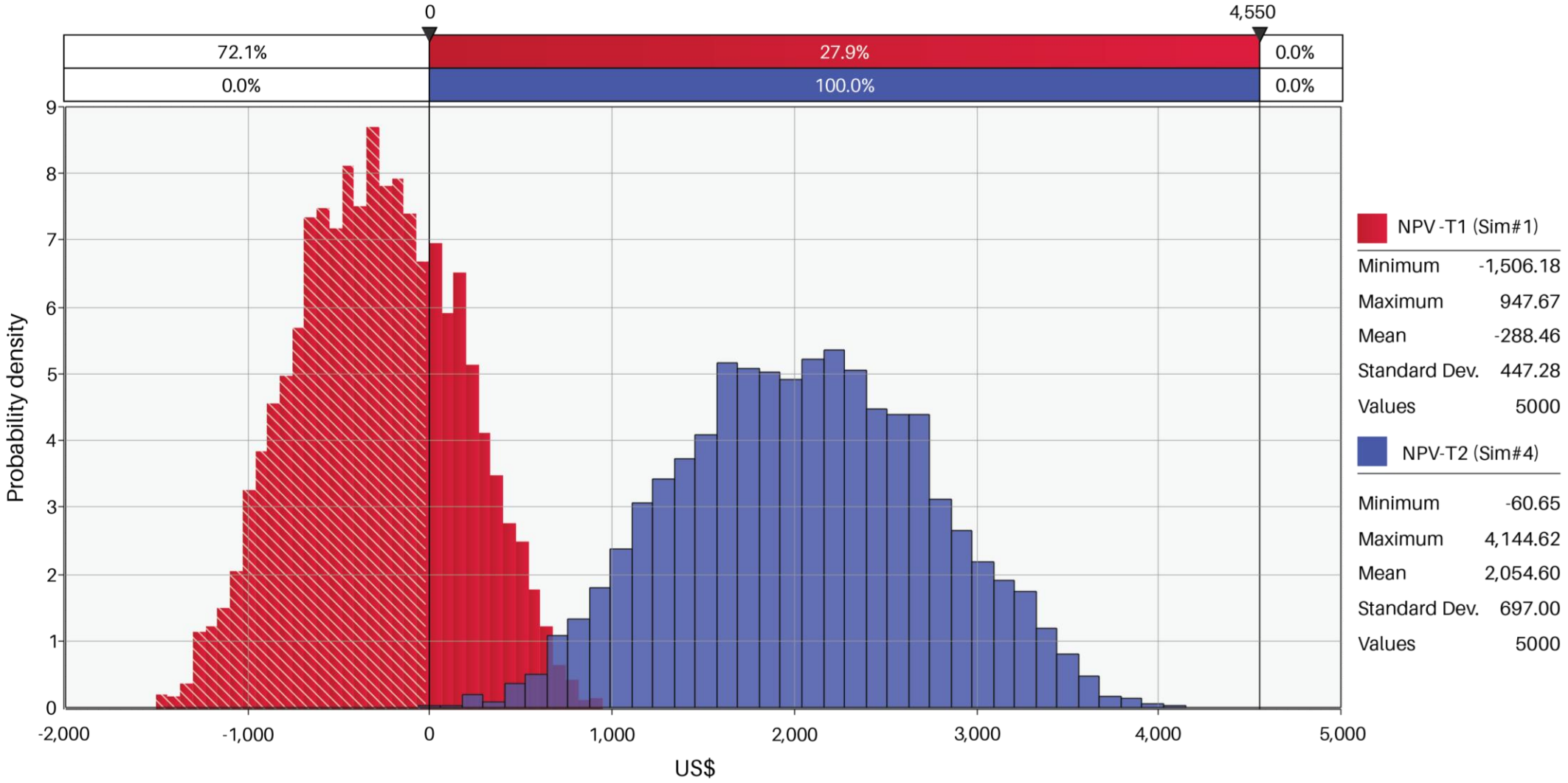


Figure 1: Probability and accumulative density distributions for the NPV for T1 and T2.

Results

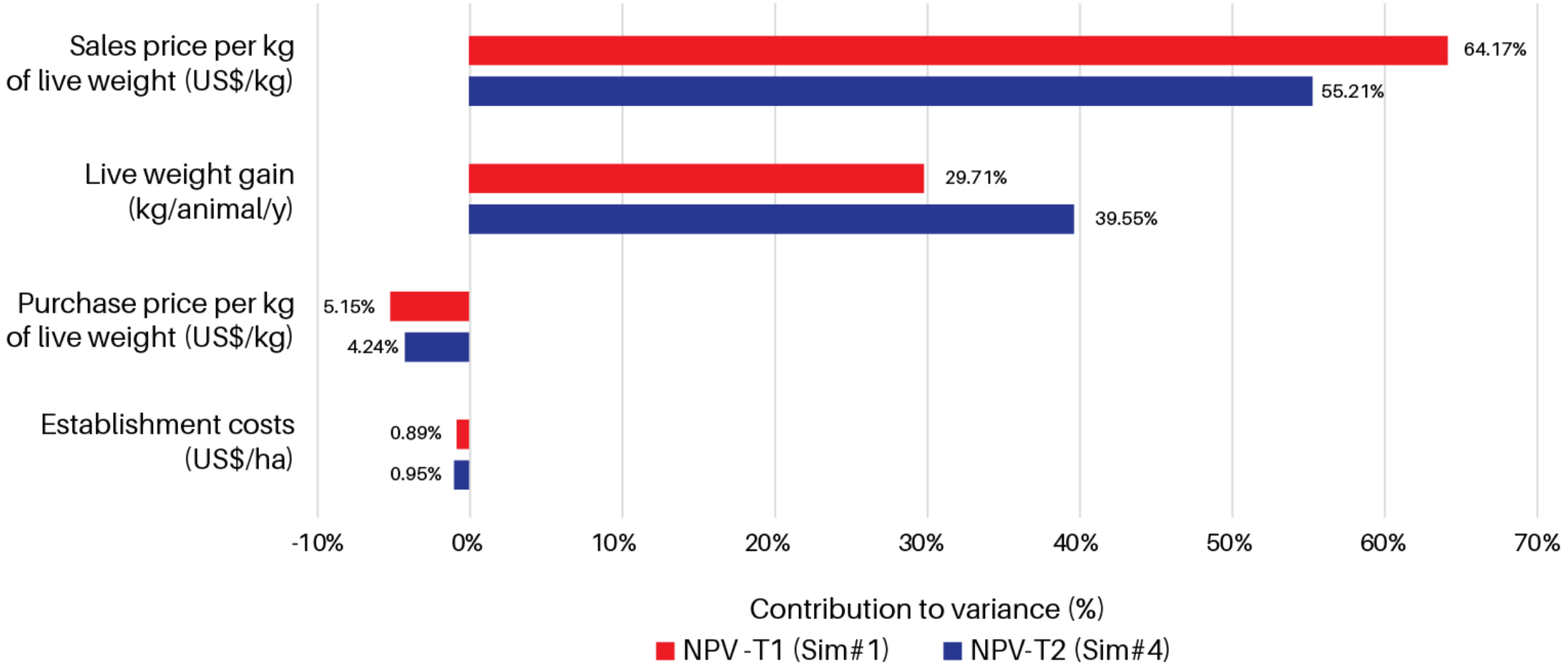


Figure 2. Multiple tornado graph displaying the contributions of random input variables to the variance of the NPV for T1 and T2.

Conclusions

- *L. diversifolia* has significant potential to **increase animal productivity and profitability**, under different scenarios of animal productivity and market conditions, which is conducive to the **sustainable intensification of meat production** in grazing systems.
- The inclusion of *L. diversifolia* comes along with a **reduction of the risk of economic loss** and less variance to changes in critical variables.
- This is key to encourage adoption, since farmers, being naturally rather risk adverse, will **most likely favor technologies with a relatively lower variance**.

Conclusions

- The establishment of grass-legume associations should be accompanied by **specific training and extension programs** that overcome the lack of knowledge and experience in the use of tropical forage legumes.
- This will **reduce uncertainties associated with technology adoption** and increase adoption rates.
- The **access to and structure of necessary financial resources** (e.g. credits) needs to be improved in order to provide the required framework for technology adoption.

Thank you!

Acknowledgements

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